

**MASSACHUSETTS INSTITUTE OF TECHNOLOGY
HAYSTACK OBSERVATORY
WESTFORD, MASSACHUSETTS 01886**

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Telephone: 617-715-5533

To: EDGES group
From: Alan E.E. Rogers
Subject: Evidence for scintillations from 3c273 in EDGES-3 at WA

The data from the WA shows occasional bumps in the spectra at 65 MHz which typically last about 1 - 2 minutes and occur at a GHA range of 17 to 19 hours. It looks these can be largely avoided by restricting the data to times when the sun is more than 10 degrees below the horizon in the GHA range of 17 to 19 hours. These "bumps" can also be filtered with an rms threshold on an integration of a few three position switch cycles. The occasional events which are seen on almost every day from day 341 2023 to day 4 2024 as shown in Figure 1 are consistent with the GHA range associated the quasar 3c273 rather than Centurus A which is suggested in memo 437 as being a potential source of scintillations for sites in the southern hemisphere. Figure 2 shows that two significant bumps of more than 10 K occur at 17.7 and 18.3 GHA on day 364 and Figure 3 shows the duration of the bump is about 3 minutes.

Observations of the Interplanetary scintillation (IPS) by the Mexican Array Radio Telescope (MEXART) at 140 MHz (Chang et al.) illustrate the IPS phenomenon in figure 1 of the paper. This shows that multiple paths occur between the Quasar and the EDGES antenna as the waves propagate though the disturbed solar wind and the effects will be strongest when the refractive effects occur close to the sun which are within the earth's orbit when the angle between the sun and 3C273 is less than 90 degrees in the table below for the location of the WA. Chang et al. 2016 point out that the power spectrum of the turbulence is expected to decrease by the fourth power of the heliocentric distance.

Table 1 shows the angle between the Sun and 3C273 at 18 hours GHA vs the day of the year. The last column of Table 1 shows the number of events with an rms of more than 2K with 5 terms removed from 58 to 102 MHz over a 50 days centered at the day number in the first column. The results in Table 1 are for day and night without any limit on the elevation of the sun.

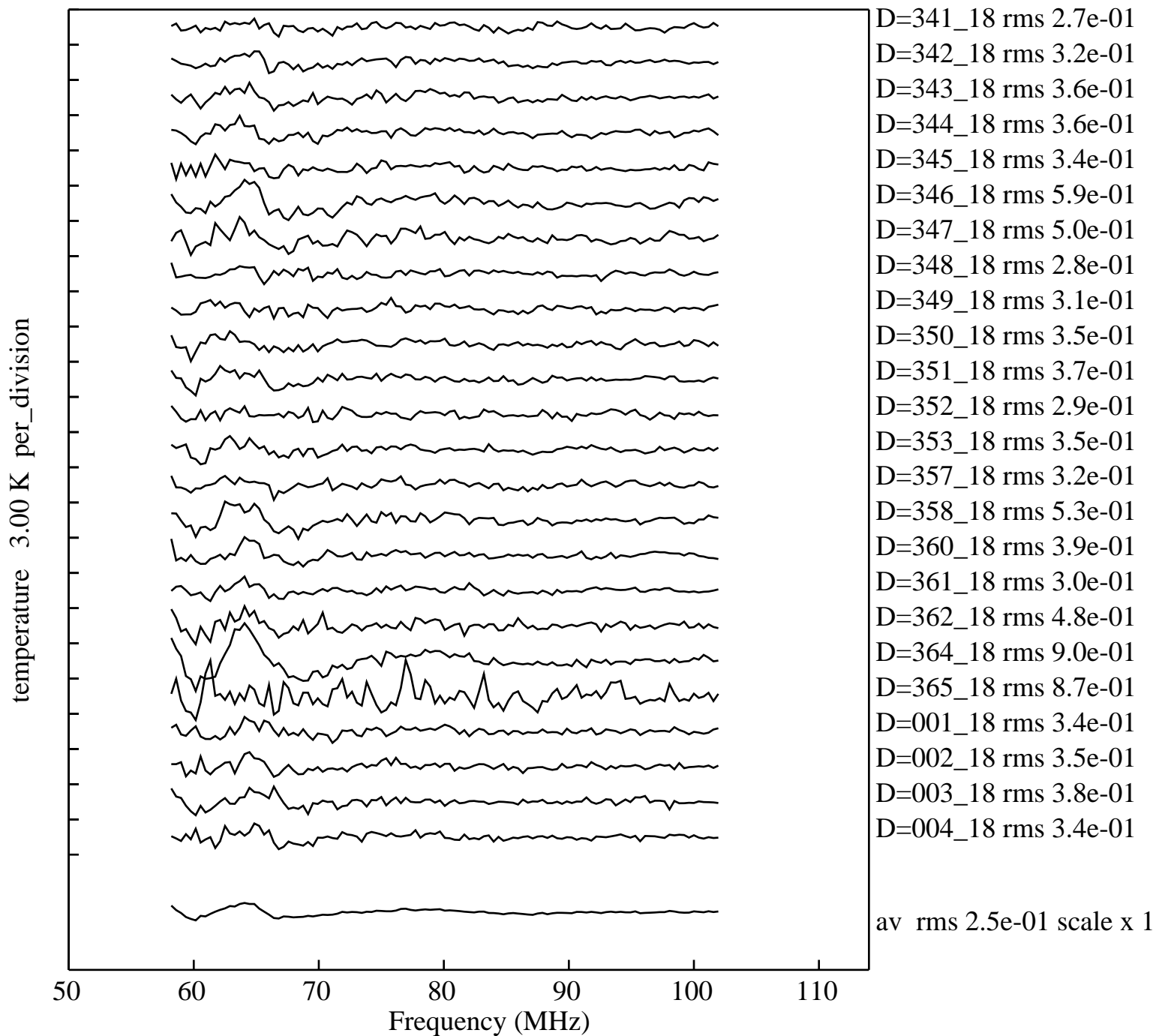
Day of the year	Angle between Sun and 3C273 degrees	Number of events over 50 day block
50	144	2
100	164	2
150	117	3
200	69	25
250	22	28
300	28	13
350	79	18

Table 1. Angle between the Sun and 3C273 at GHA = 18 hrs

If a limit of the sun being below -10 degrees only 2 events for the entire year are observed with a marginal indication of scintillation at level of 1K rms.

Reference

Chang, O., Gonzalez-Esparza, J.A. and Mejia-Ambriz, J., 2016. IPS observations at 140 MHz to study solar wind speeds and density fluctuations by MEXART. *Advances in Space Research*, 57(6), pp.1307-1313.



avrms 0.4124

Figure 1. One hour blocks at GHA = 18 hours for day 2023_341 to 2024_004.

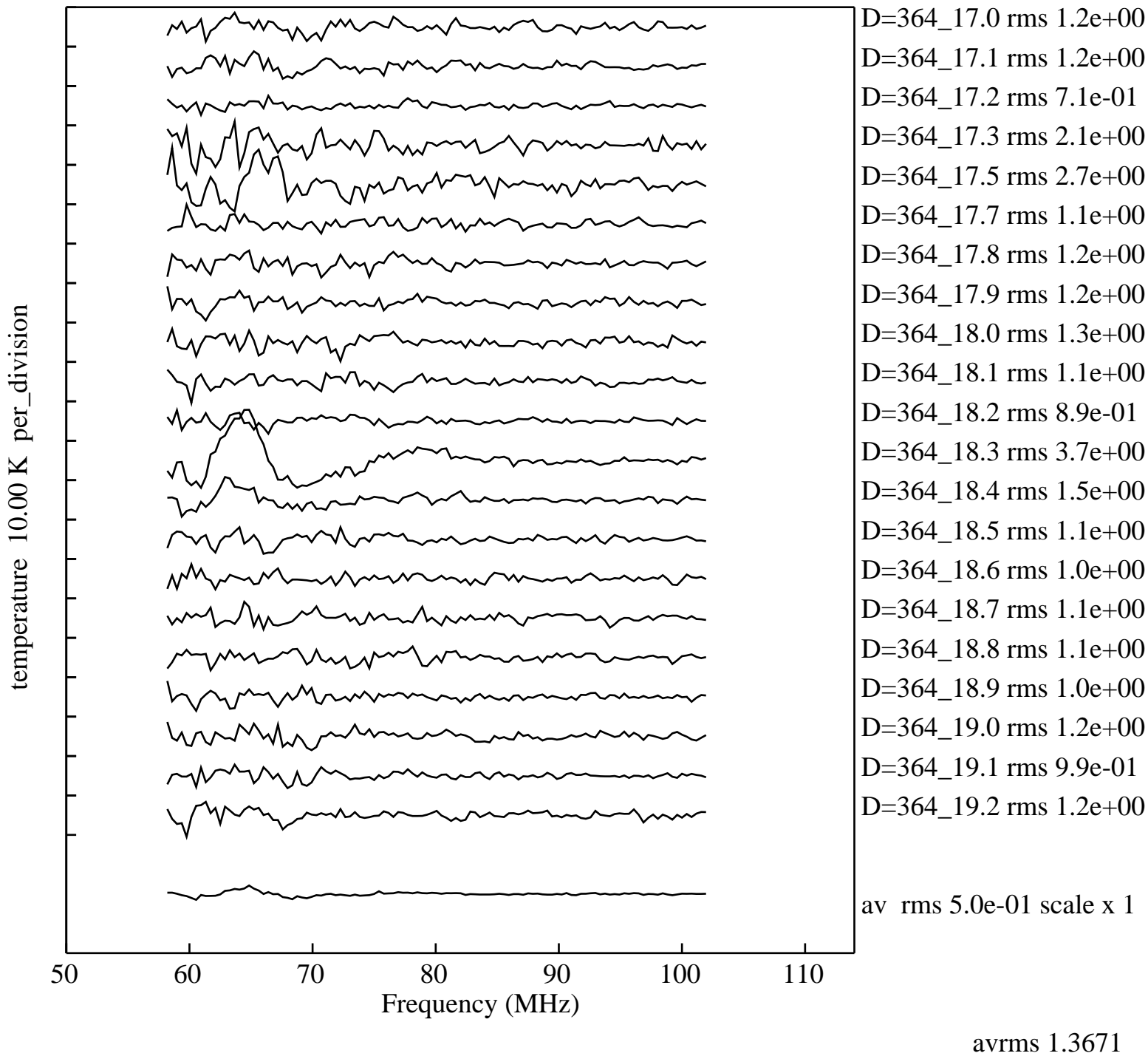


Figure 2. 6 minute blocks for day 2023_364 from GHA 17.0 to 19.2 hours.

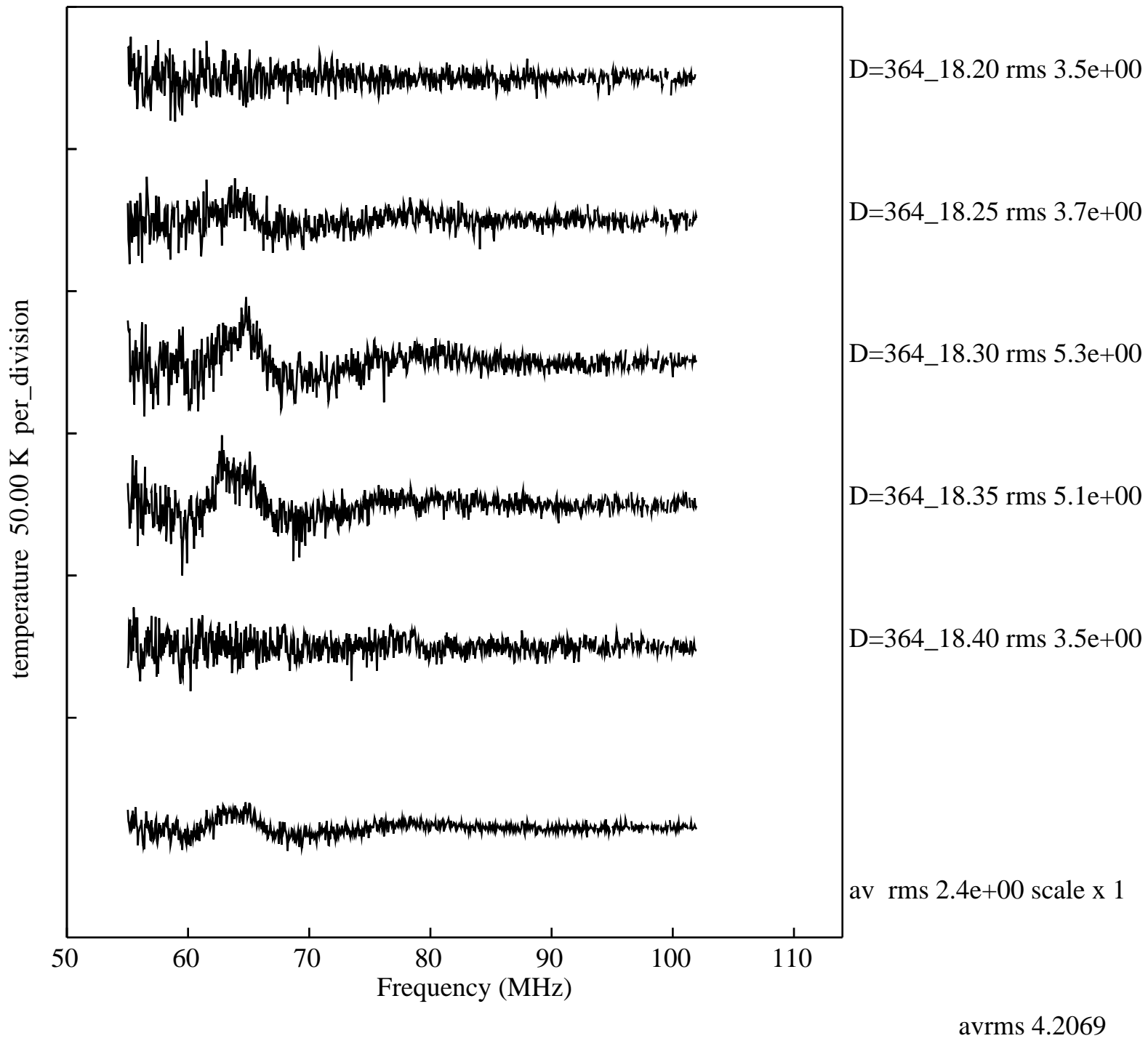


Figure 3. 3 minute blocks for day 2023_364 from GHA 18.20 to 18.4 hours with 6 kHz resolution